National Renewable Energy Laboratory

DOE Natural Gas Vehicle Platform and Engine Development

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8th National Clean Cities Conference
Oklahoma City, Oklahoma
May 14, 2002

NGV Development

- Federal and state legislation is pushing for emission reductions in fleet vehicles
- Credits and incentives are typically based on lower NO_x emissions from medium- and heavy-duty vehicles
- Natural gas provides significant NO_x reduction
  - Petroleum offset
  - Attractive transition fuel to hydrogen
- Issue: Not enough variety and quantity of medium- and heavy-duty natural gas platforms

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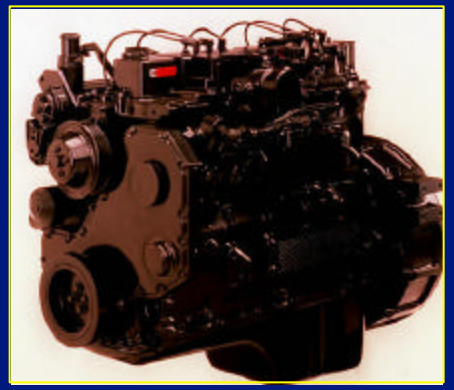
NGV Development

- Survey by Gladstein and Associates under Clean Cities Tiger Team funding to determine vehicle need and market potential
  - Vehicle candidates
    - Refuse haulers using 10- to 12-liter engines
    - Over-the-road trucks, roughly 15-liter engines
    - Medium-duty local delivery, 4- to 8-liter engines

NREL

NGV Engine and Platform Development

- DOE and NREL have initiated a coordinated engine and vehicle development program
  - Near term
    - Develop needed medium- and heavy-duty vehicles with “off-the-shelf” natural gas engines
    - Develop even cleaner, next iteration natural gas engines and certify to emissions standards
    - Incorporate refined natural gas engine into vehicle chassis
  - Longer term
    - Next Generation Natural Gas Vehicle Program (NGNGV)



NGV Platform Development

- Integrate commercially ready, EPA/CARB-certified natural gas engine into medium- or heavy-duty vehicle platforms and demonstrate performance
- Certification level
  - 2.5 g/hp-h NO_x
  - 0.1 g/hp-h PM
- Solicitation was issued and responses received
- In negotiation with potential contractor
- Candidate vehicles
  - Refuse haulers
    (front loader and side loader)
  - General pickup and delivery
  - Utility truck

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NGV Platform Development

- Project plan
  - Contractor will define a business case for a specific vehicle
    - Potential market volume, life cycle cost analysis using available purchase and fuel cost offsets, production plan
  - Vehicle will be procured and repowered with natural gas engine
  - Vehicle will be incorporated into a fleet to “work out the bugs” and verify performance
  - Modified vehicle will be made available for demonstration
  - Commercial product is the desired end result

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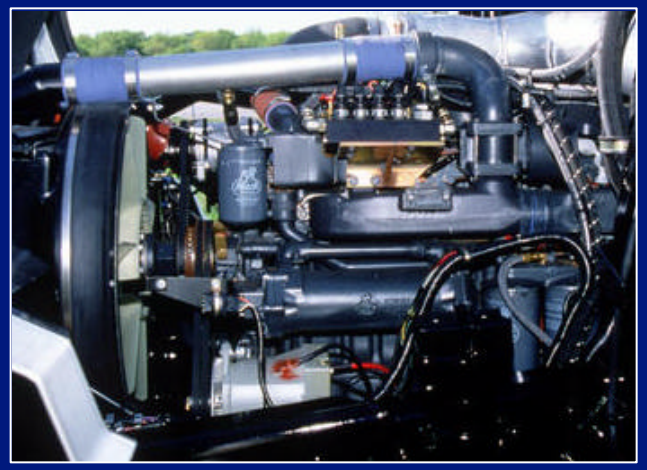
NG Engine Development

- Develop commercially viable natural gas engine
  - 230 hp, 500 ft-lb minimum
  - Certified to levels below the 2004 EPA emission standards
    - 2.5 g/hp-h (NO_x + NMHC)
    - PM at 0.1 g/hp-h for truck applications, 0.05 g/hp-h for transit bus applications
  - Capable of CARB low NO_x emission certification
    - 1.8 g/hp-h (NO_x + NMHC)



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NG Engine Development

- Project plan
  - Laboratory development
    - Selection and use of proven fuel handling subsystem
    - Laboratory testing of components
    - Transient engine calibration
    - Engine durability testing
  - Follow-on tasks
    - Accomplish on-road prototype testing in partnership with a fleet or fleets
    - Complete FTP testing and commercialize engine

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Longer Term NGNGV Program

- By 2004
  - Develop medium-duty (Class 3-6) CNG vehicle and heavy-duty (Class 7-8) LNG vehicle
  - 0.5 g/hp-h NO_x, 0.01 g PM
- By 2007
  - Develop medium-duty (Class 3-6) CNG vehicle and heavy-duty (Class 7-8) LNG vehicle
  - 0.2 g/hp-h NO_x, 0.01 g PM

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Longer Term
NGNGV Program

- Program partners
  - DOE/NREL, ORNL
  - California Energy Commission
  - California Air Resources Board
  - South Coast Air Quality Management District
  - Natural Gas Vehicle Coalition
  - Gas Technology Institute